



DEPARTMENT OF AGRICULTURE,  
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BULLETIN No. 44.

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# SHOT-HOLE BORER.

(*XYLEBORUS FORNICATUS* Eich.)

A CONTROL PRUNING SCHEME, AND ITS  
PRACTICAL MODIFICATION.

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DEPARTMENT OF AGRICULTURE, CEYLON.

BULLETIN No. 44.

**SHOT - HOLE BORER.**

(*Xyleborus fornicatus* Eich.)

**A Control Pruning Scheme, and its Practical Modification.**



HAVING established by observation and actual experiment that the tea bush under estate cultivation is least liable to attack by Shot-hole Borer Beetle at a time when the new shoots begin to appear after pruning, and for a period varying with elevation and extent of cultivation after the appearance of the new shoots, it was thought advantageous to attempt to put this temporary immunity to a practical use.

In any given tea field affected by the borer, an increase of attack takes place from the period when plucking begins until the time of the next pruning. Therefore, if the infected bushes could be recognized and re-pruned at suitable times, it was considered that some control at least would be effected.

**Detection of Infected Bushes.**

The structure of the gallery made by the borer in tea stems renders the latter liable to break when bent down. Though not infallible, it is considered that the process of bending down the branches of each individual bush renders a detection of some 98 per cent. of the infected bushes possible under estate conditions. Each branch, then, is bent down thoroughly, and the breakage of a branch denotes the presence of the borer. Often it occurs that several galleries of the insect are present in a single branch thus broken, the fracture naturally taking place at the weakest point.

**The Scheme and its Object.**

After the original pruning, it was determined that the infected bushes should be re-pruned at a period of 14 to 18 months in fields which are pruned every two years, and at two periods of 14 to 18 months and 26 to 30 months in fields which are pruned every three years.

The prunings of the infected bushes are burnt at each pruning. This disposes of the borer in the upper branches, and the natural healing of galleries below the level of pruning is relied upon to deal with a large proportion of insects in the remaining branches and in the collar. The latter control is not complete, but allows of the escape of one generation of beetles only from the time of pruning to the appearance of the new shoots.

The objects of the scheme fall under three headings :—

- (1) To prevent the borer increasing unduly at any time between the ordinary prunings.
- (2) To destroy as many beetles as possible, especially those flying from neighbouring fields.
- (3) To effect as much control as possible when most labour upon estates is available, *i.e.*, in the seasons of least flush.

#### Demonstration of the Pruning Control.

##### A.—POONAGALLA GROUP, BANDARAWELA.

A field of 38 acres was chosen at an elevation ranging from 4,000 to 4,400 feet. The tea previously to 1914 had been pruned every two years, but it was intended to run it for three years between prunings after this. The yields of made tea per acre and rainfall were as follows :—

	1913.	1914.	1915.
Yield, per acre ..	478 ..	571 ..	922
Rainfall, in inches	116·82 ..	95·20 ..	104·58

Pruning on the two-year system took place for the last time in August, 1914. In January, 1916, sixteen months after the original pruning, the branches of each bush were bent down, and every bush upon which branches broke, showing the presence of borer, was pruned down to an ordinary level of pruning. In January, 1917, 28 months after the original pruning, the process was repeated.

Estimates of the number of bushes infected were taken at intervals, and the results are best seen from the following details of the experiment :—

Acreage of field : 38 acres and 10 perches.

Elevation : 4,000 to 4,400 feet.

Jât of tea : Fair mixed Assam Hybrid.

Pruned, August, 1914 : Prunings burnt wholesale.

Manured, August, 1914 : 600 lb. mixture to the acre.

Yield of made tea per acre : September, 1914, to August 1915, 702 lb.

Rainfall : September, 1914, to August, 1915, 110·41 inches.

July, 1915, estimate of infected bushes : 4 per cent.

January to March, 1916 (16 to 18 months after pruning) :—

Number of bushes in field : 119,726.

Number of bushes infected and pruned : 19,950 = 16·6 per cent.

	Per Acre.
	Rs. c.
Cost of bending down branches and pruning ..	3 23
Cost of burning prunings ..	2 29
Total ..	<hr/> 5 52

Manure, 700 lb. mixture to the acre, applied February, 1916.

Yield of made tea per acre : September, 1915, to August, 1916, 779 lb.

Rainfall : September, 1915, to August, 1916, 106·70 inches.

August, 1916, estimate of infected bushes : 12 per cent.

January and February, 1917 (28 months after original pruning) :—

Number of bushes in field : 119,726.

Remaining unpruned from previous pruning in January, 1917 : 99,776.

Number of bushes infected and pruned : 13,572 = 13·6 per cent.

This 13·6 per cent. represents 11·3 per cent. of the total bushes in the field.

	Per Acre.
	Rs. c.
Cost of bending down branches and pruning ..	2 64
Cost of burning prunings ..	1 64
Total ..	<hr/> 4 28

Yield of made tea per acre : September, 1916, to June, 1917, 212 lb.\*

Rainfall : September, 1916, to June, 1917, 101·77 inches.

In August, 1917, the field was pruned ordinarily, except for the bushes which were pruned down in January to February, 1917 (11·3 per cent.).

The latter were allowed to run up without tipping. An estimate was made of the number of infected bushes amongst these in September, 1917, i.e., seven months after they were pruned :—

Total number of bushes : 13,572.

Estimated number attacked : 17 per cent. = 2 per cent. of the whole field.

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\* The figures here are taken during the time when crop restrictions were in force.

The branches of these bushes were bent down and the infected branches cut out at a cost of about 15 cents per acre.

The general conclusions to be drawn from these results are that the borer can be definitely prevented from increasing so long as the extra prunings are carried on.

The loss of crop, as far as can be estimated, was at most negligible, and the unevenness in the bushes produced by the intermediate prunings was scarcely noticeable after a few months.

The cost spread over three years is economic.

The failing of the control, however, lies in the amount of labour required, and this is an insuperable difficulty making a modification of the whole scheme necessary.

#### *Bushes attacked along Roads and Drains.*

During the experiment it was thought advisable to take a census of the percentage of bushes attacked along roadsides and drains, to determine if there was any likelihood of coolies carrying the insect in their clothing, or of moisture in the soil having an effect on the bushes. The percentage of bushes attacked along the roadsides was 21·2, as against 16·6 for the whole field. This is not considered a wide enough difference from which to draw any conclusion. The attacked bushes lining pathways used by coolies show a percentage infection of 23·4, as against 26·4 in the surrounding tea, a very small difference. Bushes immediately above and below drains showed a percentage attack of 20·9, as against 16·6 for the whole field, and those bounded by water-courses and ravines a percentage of 18·5, as against 22·7 in the surrounding tea. It may therefore be concluded that bushes growing in the neighbourhood of roads, drains, water-courses, ravines, and pathways are not affected in such a way as to invite more severe attack from Shot-hole Borer.

#### *Conclusions as to the nature of Attack.*

Throughout the experiment it was found time and again that the infected bushes were not distributed generally over the whole area of tea.

In the first place, exposed ridges were certainly attacked to a greater extent than the sheltered areas. For example, an exposed ridge showed a percentage of 56·9 per cent. infected bushes, as against 13·1 in a sheltered area immediately below it; another 51·8 per cent. as against 27·2 per cent.

In the second place, it was most noticeable that the infected bushes occurred in fairly definite patches, varying from 5 or 6 to 70 or 80, and surrounded by quite large areas of altogether uninfected bushes.

It would be well to compare the percentage of bushes infected in the various portions of the field during the first and second extra prunings; starting from the lower elevations and working to the higher :—

Acreage of Area.			Bushes attacked, January to March, 1916.	Bushes attacked, January to February, 1917.
A.	B.	P.	Per cent.	Per cent.
4	2	2	31.1	13.7
0	3	12	28.0	15.5
4	0	18	26.4	14.3
2	2	37	22.4	20.0
9	2	3	21.8	19.1
4	0	27	10.9	10.0
12	0	31	4.7	9.8

It is seen that in January, 1916, the percentage of attack decreases regularly as the elevation rises, but in January, 1917, there is a great reduction in those areas which were attacked worst previously, but a considerable increase at the highest elevation. It does not seem possible to explain the latter increase, but it might well have been due to a very marked increase of borer in a field lying immediately below the area in question.

#### B.—DENEGAMA ESTATE, BALANGODA.

A field of 37 acres at an elevation of about 2,000 feet and pruned every two years was treated in a similar way to the above, but with differences. Only one extra pruning was carried out at eleven months after the original pruning. At this time about  $2\frac{1}{2}$  per cent. of the bushes were found to be infected.

An adjoining field of 25 acres was treated similarly a few months later, and in the whole 62 acres only 3,187 bushes were found infected and accordingly pruned down; the cost of this, together with the burning of prunings, being Re. 1.67 per acre.

At the time of the next pruning these fields were found to be severely attacked again, and there is no doubt that the extra pruning of the infected bushes was carried out too soon after the previous pruning of the fields.



The scheme has been continued, and apparently better results obtained, and a definite control seems to have been established on certain fields at a higher elevation which were attacked more recently by the insect.

#### C.—MORAGALLA ESTATE, GALAHA.

A field of 22 acres was treated by the special pruning scheme in January and February, 1917, nineteen months after the original pruning. It was found necessary to prune down as many as 60 per cent. of the bushes, all the bushes in the lower portion of the field being badly infected. The cost of bending down the branches, pruning, and burying the prunings was Rs. 5.76 per acre.

In June, 1917, the remaining unpruned bushes were pruned at their due season. The tea of this field was comparatively young, and the yields as follows :—

	Yield, per Tree. lb.		Yield, per Tree. lb.
1913-14 ..	184	1916-17 ..	666
1914-15 ..	473	1917-18 ..	315
1915-16 ..	337		

In July, 1918, the fields were inspected and a considerable infestation was found, except in the lower portion, where 100 per cent. of the bushes had been found infected previously. In this case the pruning of the infected bushes was evidently carried out too late, and the expected reduction in attack did not take place.

It soon became apparent that the amount of supervision and labour required for this scheme demanded a decided modification, in conjunction with some means of assisting the natural control in the lower portions of the bushes, as between the time of pruning and the output of new shoots. The latter demand has been supplied by the application of a special fish oil emulsion described in a further Bulletin.

#### Modification of the Control Pruning Scheme.

Having established that the borer could be easily recognized in attacked branches, by breakage of the latter on being bent down, and having seen the small cost involved in the process during experiments on the Poonagalla Group, attention was directed to a form of field control which was being carried out by the Superintendent of the Halgolla Group, Yatiyantota. Here the method adopted was merely the cutting out from the base of all branches which contained the borer, at intervals of about two months, and the immediate destruction of them by fire. In these experiments the branches were weighed in each case.

Field.	Months after previous Pruning.	Weight of infected Branches, per Acre. lb.	Cost, per Acre. Rs. c.
A ..	First round 14 ..	373 ..	1 60
B ..	{ First round 11½ ..	225 ..	1 0
	{ Second round 13½ ..	222 ..	1 60
C ..	{ First round 10½ ..	220 ..	2 40
	{ Second round 14 ..	181 ..	2 10
	{ Third round 16 ..	160 ..	1 80
D ..	First round 13 ..	86 ..	1 20
E ..	{ First round 8 ..	81 ..	1 60
	{ Second round 10 ..	42 ..	1 44
	{ Third round 15 ..	25 ..	1 20
F ..	{ First round 3½ ..	82 ..	1 60
	{ Second round 4½ ..	43 ..	1 21
	{ Third round 10 ..	26 ..	1 15
G ..	First round 11 ..	50 ..	1 0
H ..	First round 7½ ..	26 ..	0 40

The fields were treated without any previous method of control, and for the past ten years or so have been subject to the severest attacks of Shot-hole Borer. The figures are irregular, but still point to the fact that such a scheme as this must on no account be started too late after the original pruning. Further, it is clear that at each treatment the number of infected branches has shown a reduction, when more than one round of cutting out the infected branches has been carried out. In those fields upon which the control was started later than ten months after the previous pruning, the bushes became thin from the treatment, which had to be stopped. The cost, and labour involved, prevents the possibility of removing the infected branches at such frequent intervals, and so often.

More recently, four fields on the same estate have been treated similarly, but for one round only, and at nine months after the previous pruning. The results have been as follows :—

Field.	Months after previous Pruning.	Weight of infected Branches, per Acre. lb.	Cost, per Acre. Rs. c.
I ..	9 ..	3½ ..	1 0
J ..	9 ..	9 ..	0 17
K ..	9 ..	18 ..	0 70
L ..	9 ..	20 ..	0 40

Though the costs vary on individual fields, it is clear that the labour involved for two rounds of cutting out infected branches and burning them is no great tax on an estate, and from the

experiments it has been possible to formulate a more or less definite scheme in conjunction with the application of a paint, the latter as a control for the insect in the collars and lower branches, the former to prevent undue increase in the branches between the pruning periods. The scheme is as follows :—

For *badly* attacked tea at elevation of 100 feet to 3,000 feet above sea level :—

First round of removing infected branches : 4 to 6 months after pruning.

Second round of removing infected branches : 14 to 18 months after pruning.

(For estates pruning their tea every eighteen months, only one round between the fourth and twelfth month after pruning.)

For *slightly* attacked tea at elevation of 100 to 3,000 feet above sea level :—

First round of removing infected branches : 8 to 12 months after pruning.

Second round of removing infected branches : 14 to 18 months after pruning.

(For estates pruning their tea every eighteen months, only one round between the eighth and twelfth month after pruning.)

#### Summary.

A control scheme comprising the pruning of infected bushes between the ordinary pruning periods has been instituted on a field scale. The results have been in part satisfactory, but the amount of supervision and labour required, in addition to the necessity of the scheme being carried out over very large areas simultaneously, has demanded a modification of this control. Instead of pruning down the infected bushes, it is recommended that the infected branches only be cut off from their bases at stated periods, and that these branches be burnt as soon as possible after they are cut off.

Further, to get the best results, the scheme should be tried in conjunction with the use of a special paint, recommended elsewhere, to control the borer in the lower parts of the bush at the time of pruning.

The cost of the control in the branches should not be more than Rs. 2·50 per acre at the outside.

EDWARD R. SPEYER,  
Entomologist for Shot-hole Borer.

February 18, 1919.

